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September 9, 1996

In reply, please refer to
EMD/SHW

POLICY UPDATE
Technical Guidance Manual
for Underground Storage Tank Closure and Release Response

**Update and Clarification of Recommended
Soil and Groundwater Sampling Procedures**

TO ALL INTERESTED PARTIES:

The Hawai'i Department of Health's (DOH) Solid and Hazardous Waste Branch, Underground Storage Tank Section, is issuing a policy update to its *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (August 1992). This policy update is effective immediately.

The first section of the policy update presents guidance on soil sampling methods and procedures. The guidance especially targets stockpile sampling and includes discussions on sampling strategies, recommended number of samples collected, sampling methods, PAH analyses, and comparison of sample analysis results to applicable soil action levels.

The second section of the policy update provides guidance on groundwater sampling methods and procedures. The guidance focuses on such topics as the collection of groundwater samples from open excavations, the use of vacuum-type pumps for collecting groundwater samples, and filtering of groundwater samples.

Please bring this policy update to the attention of anyone you know who may have an interest in this matter. Should you have any questions regarding this policy update, please contact the Underground Storage Tank Section at (808) 586-4226.

Sincerely,


STEVEN Y. K. CHANG, P.E., Manager
Solid & Hazardous Waste Branch

SYKC:RB:alk
Attachments

POLICY UPDATE
Technical Guidance Manual
for Underground Storage Tank Closure and Release Response

Update and Clarification of Recommended Soil and Groundwater Sampling Procedures

SOIL SAMPLING STRATEGIES AND PROCEDURES

INTRODUCTION

Guidance regarding the collection of soil samples from stockpiles presented. In addition, clarification is given on acceptable soil sampling methods as previously outlined in the Department of Health's (DOH) *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (HIDOH, 1992). The guidance provided is based on a review of published documents and discussions with environmental consultants and technical support staff in the U.S. Environmental Protection Agency Region IX. Alternative sampling procedures should be discussed with DOH prior to implementation.

BACKGROUND

The number of samples required to adequately characterize a stockpile is guided by the need to minimize the size of a "hot spot" that might be missed by the sampling event and/or also to ensure that the sample results accurately reflect average contaminant concentrations in the stockpile as a whole. The guidance presented focuses on the former concern.

Determining average contaminant concentrations in a stockpile requires implementation of a vigorous, well thought out sampling plan that is highly site-specific and dependent on the heterogeneity of soil types involved and the actual distribution of contaminant mass throughout the pile. Sampling to determine average contaminant concentrations (versus hot spots) may be especially appropriate for soil stockpiles that have been thoroughly homogenized or stockpiles where field screening for hot spots may be difficult. EPA's *Test Methods for Evaluating Solid Waste* ("SW-846", USEPA, 1986) provides guidance on the use of statistical methods for determining the appropriate number of samples needed to adequately characterize average contaminant concentrations in a given medium. Reliance on a single, quantitative model to estimate the appropriate number of samples that should be taken from any given stockpile is probably not realistic, however. This is especially true for small stockpiles (e.g., < 1,000 m³) and for investigations where funds available for collecting and analyzing samples are very limited.

Indeed, few consultants employ statistical methods to evaluate average contaminant concentrations in a stockpile. The focus has instead been primarily (and appropriately) on the detection of "hot spots" and the comparison of maximum contaminant

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concentrations detected to applicable soil action levels. The actual number of samples collected from stockpiles of similar volume and nature has, however, been very inconsistent. In this policy we provide specific guidance for the collection of soil samples based on the volume of the stockpile being sampled. The intent of the policy is to provide consistency between sites and minimize the possibility that a hot spot of significant size might be missed during sampling. When necessary, however, DOH may request additional sampling of a stockpile in order to ensure that direct-exposure and groundwater-protection objectives are being met.

In most cases, and particularly for contaminants associated with petroleum releases, hot spots that go undetected by field screening and the biased sampling scheme recommended below can be expected to pose negligible direct-exposure risks based on target objectives outlined in the DOH Risk-Based Corrective Action (RBCA) manual (HIDOH, 1996). In addition, contaminants with physio-chemical characteristics that cause them to pose a potential, significant threat to groundwater (e.g., through leaching) also commonly tend to be more readily detectable through field screening methods (e.g., moderate to high volatility).

Guidance is also provided for determining the appropriate number of soil samples that must be tested for polynuclear aromatic hydrocarbons (PAHs). Site investigation costs associated laboratory analysis has been of significant concern, particularly for contaminants where analytical fees are high (e.g., PAHs) and testing every sample for the contaminant does not yield significant, additional information. DOH has informally allowed facilities to restrict PAH analyses to samples with the highest detected concentrations of total petroleum hydrocarbon. Prior to this time, however, this had not been noted in a written policy.

DOH POLICY

Soil Sampling Strategies

When the relative magnitude of contamination can be discerned through field screening methods (e.g., visual or olfactory observations, PID measurements, immunoassay tests, etc.) then stockpile sample locations should be biased towards areas of highest suspected contamination (biased or judgmental sampling). The intent of this sampling strategy is to ensure that hot spots of contaminated soil are detected and taken into account for final comparison to applicable soil action levels.

In cases where the physio-chemical characteristics of the contaminant or low contaminant concentrations render field screening impractical then non-biased sampling strategies may be appropriate. The intent of non-biased sampling strategies is to search for hot spots or determine average contaminant concentrations in the stockpile. Guidelines for both sampling strategies are provided below.

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Procedures for Biased Sampling

Recommended Number of Samples

Unless otherwise approved or directed by DOH, stockpile soil samples should be collected and analyzed at a frequency of one sample per 20m³ of soil for the first 100m³ and one sample for each additional 100m³ of soil thereafter. (To convert cubic yards to cubic meters multiply by 0.765.) A minimum of two samples should be collected for stockpiles containing less than 40m³ of soil.

Sampling Methods

Proper methods for collecting soil samples during a site investigation and during stockpile sampling are described in the DOH TGM (HIDOH, 1992). As noted in the TGM, soil samples that are to be tested for volatile compounds (Henry's Law Constant > 0.00001 atm-m³/mol and molecular weight < 200 gm/mol) should be collected using brass or steel cylinders that are forcibly driven into the soil. This is intended to ensure that the samples are disturbed as little as possible during collection in order to help reduce the loss of volatile compounds prior to analysis. For the same reason, soil samples that are to be tested for volatile compounds should **not** be composited, either in the field or by the laboratory (Table 1). This applies to soil samples collected for the purpose of both site investigations and stockpile sampling.

Stockpile samples should be collected from depths greater than 15 cm (6 inches) below the surface of the pile. Collection of soil samples in glass jars during either a site investigation or sampling of a stockpile is recommended only in cases where metal cylinders cannot be used. When possible, the glass jars should be pushed into the soil to collect the sample rather than using a trowel to scoop the soil into the jar. Soil should be manually scooped into a brass cylinder or jar only when the nature of the soil makes the recommended procedure impossible (e.g., large rock fragments, dry hard soil, etc.). Justification should be provided in the text of the report if alternative methods of soil sampling such as this are used.

PAH Analyses

A comparison of data submitted for diesel-contaminated soils demonstrated that the concentration of polynuclear aromatic hydrocarbon compounds (PAHs) in soil with very low concentrations of Total Petroleum Hydrocarbons as diesel (TPH-diesel) is consistently well below DOH action levels. In order to reflect this experience and to help minimize unnecessary sample analysis costs, DOH is no longer requiring PAH analyses of diesel-impacted soils when the corresponding concentration of TPH-diesel is 10 mg/kg or less (typical detection limit for TPH-diesel). This policy applies only to sites where contamination is known to be restricted to diesel fuel (or other middle distillates) or diesel fuel plus gasolines. The policy does not apply to sites contaminated with heavy fuels or to sites where the contaminant source is unknown.

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In addition, DOH is allowing an assumption that soil samples with the highest detected TPH levels can also be reasonably expected to contain the highest concentration of PAHs. At this point in time this assumption is being applied only to PAHs. For stockpiles where polynuclear aromatic hydrocarbons (PAHs) are included as contaminants of concern, a minimum of one sample or 20% of the total number of samples collected, whichever is greater, should be analyzed for PAHs. (Numbers should be rounded up.) The sample(s) chosen for analysis should be reflective of the highest concentrations of total petroleum hydrocarbons (TPH) detected in the soil pile. This same strategy should also be applied for testing soil samples collected in-place during site investigation activities.

Confirmatory Contaminant Concentrations

Unless otherwise approved or directed by DOH, the maximum contaminant concentration detected in a soil stockpile should be used for final comparison to applicable soil action levels. As a general rule, but subject to discussions with DOH, hot spots should not be diluted by mixing with other soil. In some cases it may be appropriate to separate detected hot spots from soil that is not contaminated above applicable action levels in order to reduce remediation costs.

Procedures for Non-Biased Sampling

In cases where the physical nature of a contaminant (e.g., low volatility, low concentration, etc.) and available technology prohibits effective detection of hot spots through field screening, the stockpile should be sampled using non-biased sampling techniques in accordance with published guidelines (e.g., USEPA, 1986; USEPA 1991a, Pitard, 1993). The intent of this sampling scheme is to evaluate the **average** contaminant concentration in a stockpiled soil versus to delineate and evaluate hot spots as discussed earlier. Guidance on appropriate sampling methods and PAH analyses presented in the previous section should be applied to non-biased sampling programs as appropriate.

The minimum number of samples to be initially collected should be based on the volume of the stockpile, in accordance with the guidance presented in the earlier section. The need to collect additional samples from the stockpile should be statistically evaluated (refer to guidelines provided in Chapter Nine of *Test Methods for Evaluating Solid Waste* (USEPA, 1986), if possible, and/or further discussed with DOH. In some cases it may be preferable to thoroughly mix and homogenize the stockpiled soil prior to sampling in order to reduce the variance between sample results and provide a more accurate representation of average contaminant concentrations in the stockpile as a whole. Be aware, however, that mixing highly-contaminated hot spots with otherwise "clean" soil could potentially increase the volume of soil that exceeds DOH-recommended action levels and therefore increase remediation costs.

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In cases where the analytical data are shown to be statistically representative of the stockpile as a whole, the 95th percent, upper confidence limit of the arithmetic mean of the sample results should be used for final comparison to applicable soil action levels. Refer to Chapter 6, Section 4, in *Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A)* (USEPA, 1989) for additional guidance on the quantification of contaminant concentrations in impacted soils.

GROUNDWATER SAMPLING STRATEGIES AND PROCEDURES

INTRODUCTION

The following guidance updates and clarifies DOH-recommended guidance regarding groundwater sampling methods and procedures. The first section discusses the intent and use of groundwater grab samples collected from open excavations. This is followed by guidance regarding the need to filter turbid groundwater samples in order to prevent "false positives" associated with contaminants sorbed on sediment suspended in the samples. The final section allows for a limited use of vacuum-type pumps to collect groundwater samples provided that certain assumptions regarding contaminant loss are adhered to. A summary of the groundwater sampling guidelines discussed is provided in Table 1 at the end of the policy.

CLARIFICATION OF GROUNDWATER SAMPLE COLLECTION FROM OPEN EXCAVATIONS

Background

This policy statement is intended to clarify DOH's policy regarding the collection of groundwater samples from open excavations. In DOH's *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (TGM, August 1992), DOH recommends that groundwater encountered during underground storage tank removal operations be investigated for the presence of a release. Consultants have often misinterpreted this guidance to mean that DOH accepts groundwater samples collected from open pits for final confirmation purposes. Appendix 7-E of the TGM, however, clearly states that groundwater samples intended to confirm adherence to DOH-recommended action levels should be collected from monitoring wells.

The seemingly conflicting guidance can be resolved by understanding that the purpose of collecting groundwater samples from open excavations is only to qualitatively test for the presence or absence of contamination and not to quantitatively establish the actual magnitude of any contamination present. Groundwater exposed in open excavations is likely to have been highly disturbed during excavation activities. Aeration of the groundwater during excavation and exposure of the groundwater to open air can lead to a strong negative bias in the detected concentrations of volatile and/or biodegradable contaminants. Conversely, inclusion of suspended sediment in groundwater samples collected from open excavations can lead to a positive bias in the detected concentrations

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of highly sorptive contaminants, such as lead or PCBs. In view of these potential biases, laboratory analytical data for groundwater samples collected from open excavations should be used for qualitative purposes only and cannot be regarded as representative of conditions in undisturbed groundwater at the site.

Clarification of DOH Policy

Groundwater encountered during UST closure activities should be evaluated for the presence or absence of a release. The methods outlined below should be followed unless otherwise approved or directed by DOH.

Groundwater exposed in an open excavation should initially be screened in the field to determine if it has been impacted by a release. If field screening methods (visual or olfactory observations, PID readings, immunoassay tests, etc.) indicate that the groundwater has been impacted then a release to groundwater has been confirmed.

If a release is not detected by field screening methods, then a grab sample of the groundwater should be collected from the excavation and submitted to a laboratory for confirmation analysis. If the UST held petroleum products then the grab sample should be tested for the appropriate range of total petroleum hydrocarbons. If products other than petroleum were stored in the UST then characteristic contaminants associated with those products should be tested for.

Laboratory analytical data related to groundwater grab samples are considered by DOH to be qualitative in nature and cannot be used for comparison with DOH-recommended groundwater action levels. As such, there is generally no need to have grab samples for individual constituents of concern as normally recommended for specific ranges of petroleum products (e.g., BTEX, PAHs, etc.). If the laboratory analyses indicate a level of contamination above detection limits then a release has been confirmed.

If a release to the groundwater is confirmed, either by field observations or laboratory analysis of a grab sample then a properly designed monitoring well(s) should be installed at the site. The well should be installed in the area where the highest magnitude of groundwater impact is suspected. This will generally coincide with the area in or immediately surrounding the former excavation. Monitoring well design and installation and sample collection and analysis should adhere to guidelines as presented in DOH's TGM and subsequent updates. Laboratory analytical results for the sample(s) collected from the monitoring well should be used for comparison with DOH-recommended action levels for groundwater and appropriate action taken.

USE OF VACUUM-TYPE PUMPS TO COLLECT GROUNDWATER SAMPLES

Background

Vacuum-type (e.g., peristaltic) pumps offer a convenient, inexpensive means of extracting groundwater samples at sites where groundwater is within twenty-five to thirty feet of the

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ground surface. Such pumps are not traditionally recommended, however, for the collection of groundwater samples that are to be tested for volatile contaminants (Henry's Law Constant $> 0.00001 \text{ atm-m}^3/\text{mol}$, molecular weight $< 200 \text{ gm/mol}$) due to potential de-gassing problems during sampling (e.g., HIDOH, 1992; USEPA, 1993). Studies by several researchers, however, have shown that the recovery of volatile contaminants using these types of pumps is at least 50% that of samples taken with accepted groundwater sampling devices such as bailers (e.g., Ho, 1983; Unwin and Maltby, 1988; Barcelona et al, 1984; Barker and Dickout, 1988, as referenced in Parker, 1994).

Provided with this information, the Department of Health is permitting a limited use of vacuum-type pumps to collect groundwater samples as described below. With the exception of the policies described below, groundwater sampling methods should otherwise adhere to guidelines presented in the DOH document entitled *Technical Guidance Manual For Underground Storage Tank Closure and Release Response* (HIDOH, 1992).

DOH Policy

Vacuum-type (e.g., peristaltic) pumps may be used to collect groundwater samples with the following constraints: 1) the pump is operated at a low flow rate (generally $< 200 \text{ ml/minute}$); 2) contaminants of concern must have a Henry's Law Constant of less than or equal to $0.03 \text{ atm-m}^3/\text{mol}$ (refer to Table 1); and 3) a 50% sampling loss is assumed for volatile contaminants. Unless otherwise directed or approved by DOH, concentrations of volatile contaminants should be reported as the laboratory analytical results for the contaminant multiplied by two (i.e., following the assumption that 50% of the contaminant was lost during sample collection).

Sampling methods and equipment used to collect groundwater samples should be clearly described in the text of the report submitted to DOH for review. Pumps should be fitted with Teflon or polyethylene tubing (or equivalent) from the well to the Tygon/silicone tubing inside the pump. This is intended to minimize contaminant loss during sampling due to diffusion or sorption associated with the tubing.

FILTERING OF GROUNDWATER SAMPLES

Background

Analysis of unfiltered, turbid groundwater samples can lead to "false positive" reports of dissolved-phase groundwater contamination at sites, particularly with respect to heavy metals or other contaminants that generally tend to be highly sorptive and relatively insoluble (e.g., lead, benzo(a)pyrene, PCBs). In cases where false positive results are suspected, the Department of Health (DOH) routinely requests that groundwater at the site be re-sampled and that samples be filtered prior to preservation and laboratory analysis. The additional time and expense incurred by the responsible party for this repetition of work can be avoided, however, if initial groundwater samples are more appropriately collected and prepared.

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DOH Policy

Unless otherwise directed by DOH, groundwater samples that are to be tested for non-volatile constituents (Henry's Law Constant $\leq 10^{-5}$ atm-m³/mol and a molecular weight ≥ 200 grams/mol) should be filtered if there is any evidence of turbidity in the samples (e.g., turbidity > 5 NTU, refer to Table 1). Turbidity should be measured in the field during sampling as needed. Filtering of the samples should take place prior to the addition of a preservative in order to prevent leaching of otherwise sorbed-phase contaminants from suspended sediment. Filter pore sizes should be no smaller than 0.45 microns. The methods and equipment used to filter groundwater samples should be clearly described in the text of the groundwater sampling report presented to DOH for review and incorporation into the public file for the facility.

Filtering of samples that are to be tested for volatile contaminants (Henry's Law Constant $> 10^{-5}$ atm-m³/mol and a molecular weight < 200 gm/mol) should be avoided in order to minimize the loss of contaminant due to volatilization during sampling. Based on published partitioning data for low molecular weight, non-surface-reactive contaminants (e.g., volatile compounds), the contribution of sorbed or colloidal phases of these contaminants to total contaminant concentration can be expected to be insignificant (Ryan et al., in USEPA, 1995). If the collection of highly turbid groundwater samples cannot be avoided at a site (e.g., due to the placement of the monitoring well in clayey, oversaturated lagoonal sediments), then an in-line filter should be used to minimize sample disturbance. Again, this should be clearly described and justified in the text of the report.

Note that groundwater samples intended for final confirmation analysis should be collected from properly designed and installed monitoring wells unless otherwise approved or directed by DOH. Guidelines for monitoring well design and installation are provided in the DOH document entitled *Technical Guidance Manual for Underground Storage Tank Closure and Release Response* (HIDOH, 1992). Note also that proper installation, development and sampling of monitoring wells can in most cases greatly reduce the need to filter groundwater samples (e.g., refer to USEPA, 1995).

Discussion

The concentration of a contaminant in water can be measured either as dissolved-phase concentration or "total" concentration. Dissolved-phase concentrations of contaminants are most accurately measured by filtering the water sample prior to preservation and analysis (USEPA, 1991b; NJDEPE, 1992). Total concentration includes not only the dissolved phase of the contaminant in the sample but also any contaminant present in colloidal form, contaminant sorbed to particulate matter suspended in the water, pure-phase product, etc.

The groundwater action levels presented in the DOH document entitled *Risk-Based Corrective Action at Sites With Contaminated Soil and Groundwater* (HIDOH, 1996), are intended to be applied to contaminants in groundwater that are potentially mobile under natural, in-situ flow conditions. As a default, DOH assumes that the potentially mobile

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fraction of contaminants in groundwater is restricted to dissolved-phase contaminant and colloidal particles less than 0.45 microns in diameter. DOH may, however, require that unfiltered groundwater samples be collected on a site-by-site basis in order to more closely evaluate the nature and potential mobility of colloidal particles larger than 0.45 microns. For further information and references regarding the transport of colloids in groundwater refer to the USEPA document entitled *Ground Water Sampling - A Workshop Summary* (USEPA, 1995).

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Table 1. Allowance for compositing soil samples.


Contaminant	² Volatile?	³ OK to Composite Soil Samples?	⁴ OK to Filter Groundwater Samples?	OK to Collect Sample With Vacuum-Type Pump?
¹ COMMON UST-RELATED CONTAMINANTS				
Benzene	yes	NO	NO	⁵ YES(see note)
Toluene	yes	NO	NO	⁵ YES(see note)
Ethylbenzene	yes	NO	NO	⁵ YES(see note)
Xylene (mixed)	yes	NO	NO	⁵ YES(see note)
Benzo(a)pyrene	no	YES	YES	YES
Acenaphthene	yes	NO	NO	⁵ YES(see note)
Fluoranthene	no	YES	YES	YES
Naphthalene	yes	NO	NO	⁵ YES(see note)
PCE	yes	NO	NO	⁵ YES(see note)
1,1 DCE	yes	NO	NO	NO
Vinyl Chloride	yes	NO	NO	NO
TCE	yes	NO	NO	⁵ YES(see note)
1,1,1 TCA	yes	NO	NO	⁵ YES(see note)
PCBs (1260 Arochlor)	no	YES	YES	YES
TPH-residual fuels	no	YES	YES	YES
TPH-middle distillates	yes	⁶ NO (see note)	⁶ NO (see note)	YES
TPH-gasolines	yes	⁶ NO (see note)	⁶ NO (see note)	YES
⁷ OTHER CONTAMINANTS				
Acetone	yes	NO	NO	⁵ YES(see note)
Chlorobenzene	yes	NO	NO	⁵ YES(see note)
Chloroform	yes	NO	NO	⁵ YES(see note)
4,4 DDD	no	YES	YES	YES
4,4 DDE	no	YES	YES	YES
4,4 DDT	no	YES	YES	YES
Di-n-octyl phthalate	no	YES	YES	YES
Ethylene glycol	no	YES	YES	YES
Methylene chloride	yes	NO	NO	⁵ YES(see note)
2,3,7,8 TCDD (Dioxin)	no	YES	YES	YES
Chlordane	no	YES	YES	YES
Carbon tetrachloride	yes	NO	NO	⁵ YES(see note)

1. Refer to recommended chemical analysis for UST closure and release response (Table 7.2, DOH Technical Guidance Manual - August 1992).
2. Defined as Henry's Law Constant > 0.00001 m³-atm/mole and molecular weight < 200 gm/mol.
3. For biased-sampling actions, analytical results from composited samples should be multiplied by the number of samples composited to determine the maximum possible contaminant concentration in any one sample. This adjusted value should be used for comparison to applicable DOH action levels.
4. Minimum filter size 0.45μ.
5. Multiply laboratory analytical results by a factor of two for volatile contaminants.
6. Soil and groundwater samples to be tested for TPH may be composited or filtered for release verification purposes only. Any detection of TPH in the samples constitutes a release and requires followup action.
7. Contact DOH for information on contaminants not listed.

REFERENCES

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☒ APPROVED ☐ DISAPPROVED


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 Date